UNITED STATES DEPARTMENT OF AGRICULTURE
Research Program Development and Evaluation Staff
Washington, D. C. 20250

REPORT AND RECOMMENDATIONS

of the

FOURTH MEETING

of the

ANIMAL AND ANIMAL PRODUCTS RESEARCH ADVISORY COMMITTEE
Washington, D. C. February 27-March 3, 1967

Committee Membership:

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John E. Thompson, President, Reliable Packing Company, Chicago, Illinois

George L. Mehren, Assistant Secretary for Marketing and Consumer Services and Director for Science and Education - Chairman

Edwin R. Goode, Jr., Assistant Deputy Administrator, Agricultural Research Service - Vice Chairman

PREFACE

The fourth meeting of the Animal and Animal Products Research Advisory Committee was held in Washington, D.C., February 27-March 3, 1967. Mr. Cecil Robinson, a livestock producer from Delaware, Ohio, and a member of the National Agricultural Research Advisory Committee, served as liaison representative between the two committees.

To provide background information, Dr. Mehren discussed administrative and budgetary matters with major emphasis on the "National Program of Agricultural Research" which had been completed recently. Following his presentation, research administrators presented highlights of four major research areas:

Farm Research - Dr. H. A. Rodenhiser, Deputy Administrator, Agricultural Research Service
Nutrition, Consumer and Industrial Use Research - Dr. F. R. Senti, Deputy Administrator, Agricultural Research Service
Economics Research - Dr. M. L. Upchurch, Administrator, Economic Research Service
Marketing Research - Earl R. Glover, Acting Deputy Administrator for Marketing, Agricultural Research Service

During the public session on February 27, the following organizational representatives presented statements pertaining to research needs:

National Livestock and Meat Board	Dr. William C. Sherman
American Veterinary Medical Assn.	Dr. Frank Todd
American National Cattlemen's Assn.	Dr. W. T. Berry
National Pork Producers Council	Albert Gehlbach
Livestock Conservation, Inc.	John MacFarlane
National Wool Growers Assn.	Edwin E. Marsh
Institute of American Poultry Industries-	Lee Campbell
Southeastern Poultry & Egg Assn.	A. C. Smith
American Dairy Assn.	Dr. Dan Jacobson
National Dairy Council	Dr. Elwood W. Speckmann
Milk Industry Foundation	I. Linwood Tipton
Evaporated Milk Assn.	J. C. Flake

The following organizations submitted statements to the Committee prior to or during the meeting: The National Association of Animal Breeders, The American Leather Chemists Association, and The National Lamb Feeders Association.

As a basis for its recommendations, the Committee reviewed research progress reports which were supplemented by oral reports, visual materials, and discussions by leaders of research programs. Following these reviews and discussions, the Committee divided into four subcommittees: (1) animal husbandry and livestock engineering; (2) animal health; (3) utilization, nutrition, and consumer use; and (4) marketing and economics. All subcommittee recommendations were reviewed by the entire committee before they were approved for inclusion in the final report to be submitted to the Secretary of Agriculture.

Additional copies of this report may be requested from Max Hinds, Executive Secretary, Animal and Animal Products Research Advisory Committee, Research Program Development and Evaluation Staff, U. S. Department of Agriculture, Washington, D. C. 20250

I. GENERAL COMMENTS

Need for a More Profitable Agriculture

In terms of real income spent to provide their food no people in the world have ever paid as little as do our USA citizens at this time. This low cost of food is so taken for granted that it is hard to believe that it may not continue forever. During the past 15 to 25 years the movement of people out of farming has occurred at an almost unbelievable rate. This has happened without reducing the total production of food due to the fantastic gains in efficiency achieved by agriculture during this period. We believe efficiency of production will continue to improve, in fact, are certain that it must, if our own standards of living are to be maintained while we at the same time use our food to assist the underdeveloped countries to stay above starvation diets as populations explode throughout the world. But to assure this upward trend in food production it must be recognized that farming is no longer a small capital investment industry. It takes thousands of dollars more capital per farm worker than is required per worker in nearly any other industry. Capital investments of this size seek their most productive use. Capital-wise farming is not nearly as productive as it must become to stay healthy. In other words, farming is not competitive with other forms of invested capital. Few average farmers are any longer satisfied to regard their industry as "a way of life." They can sell out, move to town, put their capital in an interest bearing account, take a job in a factory or a service industry and make a better income, live easier and risk far less. They have been doing this by the thousands, particularly from dairying. If we are to continue to have cheap food or even enough food, we must now recognize the need for returns in agriculture to be competitive with returns from other uses of capital and labor. Additional research on the economics of agriculture to assure maintenance of a healthy, reasonably profitable, free enterprise farm industry may well be undertaken now.

Team Approach in Research

It has been noted that the team approach involving various disciplines has been utilized with success in the conduct of government research. It is hoped that this procedure will be continued and expanded wherever feasible.

II. GENERAL RECOMMENDATIONS

Imbalance of Funds for Animal Husbandry Research

Last year the Committee pointed out the imbalance in assignment of funds to animal husbandry research as compared with other fields of agricultural research that has occurred during the past few years. The Committee feels this imbalance even more emphatically this year. In "A National Program of Research for Agriculture" October 1966, a report of a study sponsored jointly by the Association of State Universities and Land Grant Colleges and U. S. Department of Agriculture, an inventory by commodity for farm research on page 233 shows a total of 6,304 scientist man-years for crops and animals. Of this total 2,105 man-years were devoted to animal research with 514 on beef cattle research and 601 on dairy cattle research. Sales of cattle and calves for meat make up 23% of cash farm receipts yet funds for beef cattle research represent only 7% of the amount spent on farm

research. Animal agriculture which contributes 56% of the cash receipts from farm marketings and the most important source of protein in amount and quality is receiving less than 1/3 of the funds expended for farm research. Greater support is desperately needed to solve its many problems and to make it possible for those relatively few livestock and dairy producers still remaining in these industries as compared with only 15 years ago to remain in business. To continue to produce at a profit they must continually become more efficient producers. Only greatly expanded research dealing with their problems will make this possible.

Need for Consumer Awareness on Food Safety

This Committee has recommended that increased research emphasis be placed on the detection and control of potential pathogens in dairy, meat, poultry and egg products which have been implicated in various incidents of food-borne illness. Because of the ubiquitous nature of these organisms, their complete elimination from the food supply at the point of manufacture will not in itself eliminate outbreaks of food-borne illness. A key factor in such outbreaks involves lack of appreciation for proper food handling practice by consumers and food handlers.

The Committee feels strongly that the incidence of these outbreaks can be drastically reduced by the broad dissemination of research information. We, therefore, recommend that new channels and new methods of information dissemination be explored for greater effectiveness in promoting food safety among consumers. Also, additional research has been recommended on safe food handling practices for the consumer. (See page 18.)

Salmonella

Salmonella infections constitute a serious problem in production and marketing of animal products. Research is needed on sources of infection, factors involved in cross contamination in processing, on adequate and less costly methods of detection, and on adequate methods of eliminating viable salmonella from feeds and food products. Additional comments pertaining to specific research activities are included under "market quality," page 20, "poultry disease," page 10, and "utilization," pages 14 and 16.

Antibiotic Resistance in Man and Animals

The animal industry has been accused of being responsible for antibiotic resistance in man. It has been claimed that animal bacteria become resistant to antibiotics as a result of low level feeding in poultry and other animals. Furthermore, it has been claimed that this resistance factor is passed from bacteria in animals to bacteria in humans. Cessation of the use of antibiotics in animals, particularly in poultry, could have far-reaching impact on growth and disease control. Poultry is especially suited for studies to determine whether such claims are true. This accusation must be disproved or, if confirmed, action taken to correct the problem.

Industry Recommendations

In considering research needs in marketing, the Committee was concerned about reflecting back to producers the value of their products and the guidance that producers can obtain by having knowledge of factors that operate within the marketing process. The Committee took special recogni-

tion of recommendations made by industry representatives -- particularly with respect to consumer acceptance of meat products, which in our marketing system is the ultimate test of a product. After passing the test of consumer acceptance -- a number of factors affect product value and are important to decision-makers from producer to retailer. Among these factors that influence decisions and affect product value are: grade consists, factors contributing to grade differences, cutability, value differences, and overall grading standards. Knowledge of these factors can be very important in making breeding and production plans. With this in mind, it is recommended that the requests from industry that have been presented to the Committee be brought to the attention of all divisions concerned within USDA and that proper support be provided to expedite the work recommended for both live animals and carcasses.

Weather Modification

Intensified efforts are needed to provide for further studies into artificial techniques such as cloud seeding and with emphasis on research application to the arid rangelands of the western states.

Range Management

The future of the livestock industry depends to a large degree upon the use of rangeland. Much of this land is of low productivity due to encroachment of undesirable plants and shrubs such as noxious weeds, mesquite and cedars. The future needs of the nation will require increased productivity of all rangelands. Additional research is required to find the most economical means of eliminating these competitors of the nation's grasslands.

In-depth Study of the Dairy Industry

According to information presented to the Committee plans are underway to conduct a number of in-depth studies including a study of the dairy industry. The Committee expressed its concern about the dairy industry in its report last year, therefore, recommends that prompt attention be given to the problems of the industry with special attention to three specific areas:

1. Research aimed at reducing production costs and improving the competitive position of dairy farmers.

   The dairy industry is essential to the well-being of this country. It is vital to the food supply. Of the total nutrients available for human consumption, milk and milk products provide 24% of the protein, 16% of the energy, 19% of the fat, 77% of the calcium, and 44% of the riboflavin. Nearly 75% of the feed protein needs of dairy cows is provided from forages which can be produced on available lands not needed in the production of food crops. The vital dairy industry is being threatened by a continuing and alarming rate of dairy cattle and farm disposal. In 1966 total milk production dropped and surpluses largely disappeared and some shortages occurred. There are strong indications that these trends are continuing. This loss in numbers of dairy cows and sale of dairy farms is to a large degree attributed to rising production costs and favorable off-farm opportunities.

2. A review of standards for dairy products, especially butter and retail cream products.

   Butter was defined by an Act of Congress in 1923. The Act stipulated the minimum milk fat content and limited the permissible additives to salt and color. The definition for butter has not been changed in the 44 years since 1923. The standards established at that time were probably realistic and necessary. They were supported by the industry as a means of regulating the manufacture of these products under the conditions prevailing at the time. A re-examination of these standards in relation to the current market situation is needed. Research and development efforts on dairy products are and have been limited or discouraged in recent years by the rigid standards in force on certain products. The "spread" market has changed from a market almost totally dominated by butter to the current situation with margarine accounting for the major share of this market. Margarines are the products of advanced processing technology and additives which are illegal under butter standards are permissible under margarine standards which have been developed by that industry. Under present market conditions, the annual sales volume of about $1 billion in butter represents a very important market in this country. The feasibility of revising or modernizing the butter standards should be considered at this time as a means of stimulating work on new products made from milk fat and providing greater marketing opportunities for this important milk constituent.

3. Product innovation for dairy products.

   A nationwide dairy organization has proposed the establishment of a national research center for product innovation in dairy products. This matter needs to be evaluated as to its feasibility and practicality.

Consumption Statistics for Fluid Milk and Fluid Milk Products

At the present time the USDA develops and reports fluid milk consumption in terms of its butterfat milk equivalent. In some cases this method does not adequately recognize trends in use of skim milk items even though consumption of major as well as minor products are reported in product pounds including sales of fluid milk items. Small declines in the butterfat content of the fluid milk or the fluid cream which is consumed reflects a magnified decline in the milk equivalent figure. This has created an impression of a declining industry and indicates a decline in the amount of some food nutrients recommended by nutritionists which are regularly supplied in the diet by milk. About 65% of the sales of fluid milk and cream products is subject to Federal milk marketing orders. The statistics available from this source are in terms of product pounds and are quite good. Likewise, another 20% is under some form of regulation by State milk control with quite good statistics. Good data are presently available for some 85% of the U. S. milk sales. However, coverage of the remaining 15% is needed to adequately measure sales.

We recommend that steps be taken to collect as much additional information as possible and that present consumption statistics for fluid milk and fluid milk products be converted from a milk equivalent basis to a product pound basis for (1) fluid milk, (2) low-fat milk, (3) skim milk, and (4) fluid cream and fluid cream products.

We request this not only as a basis for decision-making in industry but to furnish a basis for the many research uses of these data and the effect on research conclusions which may be derived from the present data.

Livestock Inventory

Research should be conducted that would indicate how to achieve greater accuracy in the January 1 livestock inventory report issued each year. The inventory reports are based on Census enumerations as a benchmark. In inter-Census years the year-to-year changes are based on sample surveys. When Census data become available, it is necessary to review the estimates for the previous five years and, if necessary, to make revisions to bring the level of estimates in line with Census enumerations. These revisions accumulate over the 5-year period and at the end of the period can result in a change of several percentage points. Even though the changes are small for each individual year, the cumulative change at the end of the period frequently causes considerable concern in the industry.

With the technological changes that have taken place during the past ten years or more, further research on methods of collecting data would be beneficial in helping to attain greater accuracy in current reports.

Of greatest concern is the methodology being used to establish the statistical base for reporting and to recognize the variables that occur which cause fluctuations between estimates and actual. Since these reports are used for all manner of business decisions in the livestock industry and for research, it is important that they be as accurate as possible.

Sheep Industry Vital to Nation

The sheep industry is vital to the national defense of this country. It provides income for one out of every nine farm families. It utilizes profitably many lands that are not otherwise used. The industry is threatened with mounting competition from synthetic fibers and foods; increasing costs of raising sheep; increasing imports of manufactured wool fabrics; changing structures of marketing, manufacturing, retailing of industry products and changing consumer preferences. An additional threat to the continued health and growth of the sheep industry is the decreasing availability of public lands for raising sheep. Increasing demands for reclamation, watersheds, reservoirs, wildlife, and recreation areas are presenting formidable competitive factors to the sheep industry in the western area of the United States. A study is needed on the release of additional public lands for use in producing domestic livestock. Expanded research is needed to investigate possibilities for intensified production, improved reproductive rates, increased growth rates, improved feed efficiency, and increased consumer acceptance of lamb meat and wool. Estimates indicate that such research could result in savings of over $300 million annually to the sheep industry and consumers. The place of the sheep industry in the American economy needs to be kept in mind and research support provided.

Rabbit Research

Rabbit research by USDA was discontinued two years ago. Because of the needs of medical science for laboratory animals, the possibility of a new meat source comparable to poultry, the potential advantages of rabbit production as income opportunities for the elderly and the young, and an enterprise that lends itself to semiurban areas, it is recommended that a

rabbit research program be conducted involving the disciplines of husbandry, nutrition, genetics, physiology, pathology, utilization, and marketing, and that a coordinating mechanism or authority be established to direct the program.

This area of research might well be conducted within existing research divisions without establishing a separate station; however, it is important that the coordinating mechanism be sufficiently effective to avoid the overlooking, or neglect of the program so that it becomes the stepchild in a division where investigators are not interested in it. It may have been in the public interest to close the separate rabbit experiment station but there is concern as to whether it is in the public interest to withdraw research from this industry at a time when its economic importance may be close to a major breakthrough as a full member of the agricultural sector of the economy.

Rabbit production is important in support of medical research and other aspects of basic life science research. Animal numbers are far below actual demand for medical research and teaching. Rabbit production offers an important potential source of meat. These animals share with poultry many desirable characteristics such as adaptability to mass production in close confinement, year-round production, and adaptability to widely decentralized production. Compared with poultry as an enterprise, rabbits have the ability to grow on rations comprised largely of low-cost and low-usability roughage whereas poultry require rations of concentrates and feedstuffs that are more or less in competition with the human population. There may be a possibility for this infant industry to generate into a major food industry. Rabbit projects in 4-H Clubs have demonstrated the feasibility of production by young persons. Likewise, elderly persons could take advantage of the low capital cost to start a business. The small size of the animal and its gentle nature are factors that make handling suitable for young and old. Rabbit production is better suited to development in semiurban areas than most animal operations. There are fewer noxious wastes and less likelihood of the operation becoming a community nuisance.

The immediate research needs are for more information on methods of detection and control of rabbit diseases and parasites, on methods for more efficient production, and on methods for improving the quality of the animals. Practically no attention is being given to these problems by State or other experiment stations.

Swine as a Laboratory Animal in Human Medical Research

The development of the miniature pig for medical research emphasizes the great similarity of swine and human biological processes. Expansion of basic biological knowledge on swine is of tremendous importance in many areas of human research. The needs of human research partially justify the expansion of basic swine research efforts.

Facilities at the Agricultural Research Center, Beltsville, Maryland

Animal Husbandry

The Committee is highly disturbed by the inadequacy, deterioriation, and antiquated state of many of the buildings and facilities used by Animal Husbandry at the Agricultural Research Center, Beltsville, Maryland. The

installation needs extensive renovation, replacement and general modernization if it is to serve the needs of basic research for the livestock industry and to attract and keep qualified personnel. For decades this research center has been looked upon as the focal point and showplace of American agriculture but, in reality, its physical facilities are a disgrace to our national image for all who visit there. The Committee strongly urges and recommends that steps be taken by the Department of Agriculture to apprise our congressional leadership of these conditions and needs at Beltsville; and an all-out effort be made to obtain necessary funds to recondition, replace and modernize existing buildings and facilities.

Parasitology Laboratory

An examination and review of the Beltsville Parasitological Laboratory reveals the fact that there is a very urgent need for an appropriate slaughterhouse, autopsy room, and incinerator in order to properly handle carcasses of experimental animals and to comply with sanitary requirements in the area.

In the parasitology laboratory building is the internationally famous Index and Catalogue of Medical and Veterinary Zoology, however, it is insecurely maintained and a fireproof facility should promptly be provided. The Collection and Index was started in the late 1800's. The Index now contains 3,500,000 reference cards and represents the effort of several generations of scientists and could not be replaced if lost or destroyed. The same is true for the 63,000 lots of specimens in the Parasite Collection. Additions are being made constantly to both the Collection and Index. This Committee has urged construction of a fireproof facility repeatedly in its last four reports.

Also, plans should be made for expanded facilities and to employ more scientists to conduct the research work in this discipline which is so urgently needed.

Centralized Headquarters for Human Nutrition Research

The Committee notes with regret that once again the Department's budget request does not include plans to construct a central headquarters building for human nutrition research at Beltsville. We urge that plans and construction of this facility be undertaken at the earliest possible moment. We strongly support the high priority for such research in the long-range plans of the Department and the recognition given this area of study as an important goal in the Department's program to improve the well-being of people. A central headquarters facility at Beltsville will improve nutrition research capabilities and coordination, will enable studies with human subjects not possible in the several facilities now available, and will provide ready access to the reference materials in the National Library of Agriculture.

Facilities Away from Beltsville

U. S. Meat Animal Research Center, Clay Center, Nebraska

The procedural arrangements including acquisition of land and official designation of a United States Meat Animal Research Center located at Clay Center, Nebraska, have been completed. Phase I, planning and letting of contracts for construction of buildings for animal husbandry research is

scheduled to be completed this year. Phase II, staffing and completion of remaining facilities for animal husbandry and development of facilities scheduled for agricultural engineering and market quality research should be initiated without delay.

The importance of this facility to three major livestock groups -- beef, sheep and swine -- and the interrelationship of husbandry, engineering, and marketing make this project the number one request of the Committee. We request that funds be made available on a top priority basis for completing Phase II, in order to carry out the research program recommended in the National Program of Research for Agriculture.

This program of research for the future calls for a substantial addition of Federal and State scientist man-years by 1977 to deal with such problems as reproductive inefficiency, efficiency of feed utilization, animal waste disposal, integrated production and management systems, and acceptability of animal products.

The planned scale of operations and specialized facilities will permit investigations which heretofore have not been possible at other locations. The facility and land resources are being developed to support and complement the total Federal-State meat animal research program. On the basis of conservative estimates, knowledge gained from this research could easily save $500,000,000 annually in the production of the U. S. meat supply or the equivalent of more than 20¢ per pound of beef in consumer's prices.

North Central Dairy Cattle Forage Utilization Laboratory

The Committee reaffirms and strengthens the recommendation made last year to establish such a laboratory to concentrate particularly on the use of roughages for dairy cattle. Such a laboratory would contribute substantially to the economic position of the modern family-size dairy farm by conducting investigations on: (1) the evaluation of forages as feeds; (2) the role of the rumen in forage utilization; (3) the effects of forage concentrate ratios on milk yield and composition; (4) the nutritional and production consequences of adjusting, harvesting, preserving and feeding practices in accordance with the economic changes; (5) the development of cattle that will utilize forages more effectively; and (6) increase the contribution of protein from forage and other nonfood materials to furnish the protein needs for high milk production. The proposed laboratory should be located on or adjacent to the campus of a land-grant institution. The research should be conducted jointly with the State in which the laboratory is located and should be planned cooperatively with the State Agricultural Experiment Stations of the North Central Region.

Poultry Research Laboratories

The Committee is pleased to learn of the research underway at the regional poultry laboratories in East Lansing, Michigan; Athens, Georgia; State College, Mississippi; and Glendale, Arizona. It is also pleased to learn of the progress now underway in relocating the leukosis research facilities at East Lansing and the prospect of completion in 1968 of the new laboratory authorized at Georgetown, Delaware. The Committee urges that sufficient funds be made available to fully staff and equip all of these laboratories as quickly as possible and that projects and personnel be assigned each in keeping with its particular physical facilities and potentials.

Facility - Location Undetermined

Center for Experimental Animals

In view of the continuing need for more species and better experimental animals and requirements of Public Law 89-544, facilities should be provided where different species of animals can be maintained and bred and problems related to them can be studied. Information obtained from such a project would be most useful in other laboratories where experimental animals are used for biomedical research.

Facilities - Additions or Modifications

National Animal Disease Laboratory - Ames, Iowa

Crowded and limited space for animal disease research activities at the National Animal Disease Laboratory does not permit expansion or intensifying research work on several diseases in livestock and poultry mentioned in the Animal Health section of this report. The release of space now occupied by the laboratories serving the regulatory activities would help alleviate the space problem. Separate facilities for this excellent service rendered by the agency should be provided or additions made to the existing laboratories. This matter was the subject of a special study group and reported in early 1966 to the Department of Agriculture.

Animal Disease Research Laboratory - Denver, Colorado

An excellent but small group of scientists in the Denver laboratory have made notable contributions in the past few years, especially in studies regarding bluetongue in sheep and cattle. However, their progress is greatly hampered because of a lack of adequate facilities to house and handle experimental animals (cattle and sheep) in sufficient numbers. Therefore, such needed facilities should be provided at an early date in order to continue and expand research work in this disease of great concern to the sheep and cattle industry.

Woolen System - Albany, California

It is recommended that facilities be provided at Albany, California, and research be initiated on the woolen system of wool processing in order to take advantage of wide opportunities, including durable press, which have been opened for wool. Such facilities for research on wool and mohair are presently not available in the wool and mohair industry. Present Department facilities at Albany are limited to the worsted system. The lack of the woolen system at Albany limits progress in research toward superior durable press wool and mohair products and other products made from variously modified wools and mohair. The manufacture of woolen fabrics presents unique problems in blending, carding, spinning, and finishing which are not receiving attention at present. Moreover, the woolen system of manufacturing consumes a greater proportion of domestic wools.

NOTES

III. ANIMAL HUSBANDRY AND LIVESTOCK ENGINEERING

The Committee observes that the Department of Agriculture provides fewer than ten scientific man-years for swine husbandry research. In terms of the size of the swine industry, which provides approximately one-third of the nation's meat, representing nearly 8.2% of the nation's total expenditures for food, this is a woefully small effort. The producers face a large number of production problems that justify an immediate and significant increase in the Department's animal husbandry swine research program. Also, on the basis of the ratio of scientists to cash farm receipts, the effort on beef research is equally low.

A. Reproduction Performance

Dairy. Physiological and management research needs to be expanded. Additional knowledge is needed which would increase the reproductive efficiency of dairy cows and bulls by reducing embryonic mortality, minimize ovarian dysfunction, improve semen production and increase the efficiency of semen utilization and control of sex.

Poultry. Rate of egg production, fertility and hatchability continue to be major problems in both chicken and turkey production. This is especially true in the case of turkeys. It is recommended that a project or projects be developed involving studies in genetics, physiology, nutrition, management, and other appropriate areas to improve these conditions. In this connection further studies in artificial insemination, especially in turkeys, are needed.

Beef. In 1965 6.5 million beef cows failed to calve. Maintenance of these barren cows cost cattlemen an estimated 526 million dollars, equivalent to nearly 3 cents a pound of wholesale beef. Research, as proposed for the U. S. Meat Animal Research Center, Clay Center, Nebraska, on this problem should reduce these costs by 1/3 in 10 years' time with resulting savings to the ultimate consumer of about 175 million dollars a year. This research includes expansion of the genetic, physiological and management aspects that would improve efficiency of reproduction of females and males to solve this number one problem of cattlemen. Much more knowledge in physiological genetics in relation to reproduction, nutritional needs for optimum reproduction and systems of breeding beef cattle is needed.

Swine. Approximately five percent of the sows kept for breeding purposes are incapable of normal reproduction. An additional 15 percent that breed do not farrow. Fertilization failure and embryonic death loss reduces potential litter size from 15 eggs ovulated to less than 10 pigs born alive. The financial loss to producers from sow reproductive inefficiency exceeds $125 million annually. Greater knowledge of basic swine biology and the response of breeding sows to environmental conditions is urgently needed.

Recent studies of human birth defects indicate that maternal environment is frequently responsible for imperfections of body form and function. Early swine studies that classified similar defects as genetic in origin are likely inaccurate. The occurrence of such defects in swine is recognized as cause for culling the sows and boars involved and, if not of genetic origin, imposes an unnecessary cost on genetic improvement efforts. Research to determine genetic and nongenetic causes of swine birth defects is desirable. Defects, which are caused by identifiable treatments or conditions, are potential means of charting developmental sequences.

Artificial insemination is a useful swine breeding tool but its utility would be greatly increased by the development of a method to deep-freeze and preserve sperm cells of genetically superior boars.

Estrous synchronization is a promising means of reducing breeding costs while grouping farrowings for efficient management, production and marketing. Combined with artificial insemination it could extend the use of superior sires and speed the genetic improvement of swine. Expanded and intensified research is needed on factors affecting estrous detection, estrous synchronization, semen production, and reproductive capacity.

Sheep. Expanded research is urgently needed to improve the reproductive efficiency of sheep and to bring about rapid increases in the annual number of lambs weaned per ewe. Lambing rates have a high relationship to net income in sheep enterprises. The contribution from such research has a potential of $82,000,000 annually through savings in the number of ewes needed to provide enough lambs to meet present lamb consumption needs.

Specific research projects would include: the improvement of ewe fertility, development of twice a year lambing, increased control of the ovulation rate, development of methods to shorten the post partum interval, and improvement of feeds and methods of raising lambs without their mothers. Also, to improve the breeding efficiency of rams the development of a more accurate fertility testing procedure and the improvement of sperm production capacity would provide more highly fertile rams and allow more consistent and uniform lambing. There is a need to develop practical methods of storing ram semen so that artificial insemination of ewes would be more practical. Successful storage of frozen ram semen and artificial insemination of ewes would allow widespread use of superior rams and would speed up the production of consumer-preferred lambs and high yielding wool-producing sheep.

Goats. Additional research is needed to improve the reproductive rate of the Angora goat.

B. Feed Efficiency

Present studies need to be expanded and new research undertaken to provide a better understanding of the nutritional and management requirements of newborn farm animals to avoid and minimize disorders, to reduce losses, and to enhance growth and development during this critical period.

Poultry. Continuous research should be conducted in genetics, nutrition, feed composition, environment, and breed selection to constantly improve utilization and conversion ratios of broilers, hens, and turkeys.

Beef. If the feed efficiency were to be increased only 10 percent, an annual saving approximating 252 million dollars could be made in the cost of beef production. This may be attained by expanding genetic research in this field and by fundamental research of ruminant nutrition emphasizing utilization of urea and other nonprotein nitrogen sources and their relationship to fat in the ration. As protein sources become more and more expensive, expanding research into improved roughage utilization becomes more urgent.

Fundamental research is needed to determine the mechanisms whereby various hormones and hormonelike compounds improve animal performance and the interactions of these materials with different nutrients. At the present time, these compounds are being widely used in beef cattle feeding programs yet very little is known of their mode of action in the animal body. A knowledge or understanding of mode of action could be immensely valuable in developing new compounds of greater effectiveness but with minimum side effects and residue problems.

Research is needed on techniques for evaluating range and pasture forages. The importance of forages to beef cattle operations is well-recognized. However, techniques for determining the productive value of forages for beef cattle are inadequate. Such research should be basic and aimed at establishing a foundation of knowledge for subsequent forage evaluation studies and to serve as bases for forage breeding and cultural research.

Expand research into nutrition and feeding methods to be followed with heifers to increase the rate of gain in finishing.

Swine. Additional research is needed to specify the nutrient requirements of newborn pigs and to assure the survival and efficient growth of early weaned pigs. The nutrient requirements for maximum ovulation rate in young females, for maximum embryonic survival at the critical implantation stage of gestation and for sow conditioning at parturition, require further research.

Alternative sources of nutrients, particularly protein sources that provide suitable levels of lysine and tryptophan, the limiting amino acids in swine feedstuffs, need further evaluation in anticipation of increased competition for existing supplies by humans.

The opportunities for increased feed efficiency resulting from genetic improvement that lowers carcass fat percentage and increases growth rate thus reducing energy supplies needed for maintenance of body functions requires further investigation.

Sheep. Efficiency of feed conversion is one area in which the sheep industry has a long way to go compared with many other segments of the meat industry. Considerable research is needed in this area not only from the standpoint of producing more pounds of gain per pound of feed but more pounds of red meat per pound of feed.

C. Environmental Stress in Production

Dairy. Research is needed to develop ways to improve the production and efficiency of milk cows under environmental stress and when managed in large numbers. Effort should be given to physiological, genetic and feed intake stress and limitations at high levels of production, recommended management systems in extreme temperatures and climatic conditions, and the adaptability of individual cows to group feeding and husbandry systems.

Swine. Research is needed to identify the conditions of housing, ventilation, and waste removal that minimize environmental stress. Swine producers that finish hogs in confinement report an increased death loss among pigs loaded and transported to market. The possible relationship of meatiness and loss susceptibility should be studied.

Data show that the conception rate is reduced by approximately 15% in the six warmest months of the year. This costs swine producers over 1/2 million dollars annually. Studies are needed to determine the effect of temperature and humidity on semen production, quality, and conception rate in boars, and on fertilization rate, implantation, and fetal development in females. Losses at birth average 2.2 pigs per litter. The loss of one pig, if caused by environmental stress factors, would exceed $250 million annually. Considerable research emphasis is needed to clarify stress influence at birth and to reduce this waste.

Poultry. Research is needed to investigate the stress placed upon caged layers and broilers.

Goats. A method needs to be developed whereby a freshly shorn Angora goat exposed to low temperature, wind and rainfall will not die. This might possibly be done by application of proper liquids to coat the animal and to protect it from the elements.

D. Production Management Systems

Dairy. Production efficiency and net incomes of producers could be improved by developing dairy farm records as a management planning aid by (1) expanding the scope of dairy production records to include physical quantities and dollar costs of production inputs for the whole farm as well as the dairy enterprise, and (2) developing procedures for using dairy production and feed records as a basis for determining the most profitable composition and amount of grain and forage to feed. Research on record performances is needed to accelerate genetic progress through mass selection. Studies on weighing, testing and sampling devices is urgently needed to make possible more effective record utilization studies and on the farm applications.

Research needs to be initiated and expanded on the biochemical, immunological and physiological traits of dairy cattle blood, milk and other tissues, in order to learn their relation to production and other performance characteristics, to determine the nature of their inheritance, and to reveal new possibilities for early and accurate detection of superior animals.

Beef. Effective performance and progeny testing programs coupled with research in breeding systems and crossbreeding could develop efficiency of meat production greatly. The wide variety of environments encountered from range to confinement rearing and feeding indicate that studies into specific breeds and crosses should be expanded. Studies are needed to indicate the most suitable breeding systems that would provide an optimum national beef production industry. Also, theoretical studies are needed to develop information that could serve as a guide for the amount of seedstock needed to maintain an adequate population for a vigorous, efficient national beef herd. These studies would be valuable for future planning.

Expanded genetic research coupled with management research may increase beef cows' calf bearing years. Presently, the average beef cow produces 4 to 5 calves. Extension of her life to produce one more calf would save cattlemen about $15 per year replacement cost. On our 32,000,000 cow national beef herd this would total $480 million.

Expanded genetic studies could improve beef cows' efficiency to raise their calves from an average of 400 pounds to 500 pounds in the same period of time. By expanding genetic research in breeding for this factor and improving management, it is estimated that a 25-pound increase could be made in 10 years time and would then save producers an estimated 96 million dollars per year.

Swine. Rising land values and labor costs are causing producers to adopt confinement farrowing and finishing systems, to develop larger, specialized hog production facilities that represent substantial investments in equipment and buildings. Swine producers urgently need research to determine the relationship of production efficiency and types and location of feed supply, markets, size of production units and production technology. Problems of waste disposal, including possible salvage, are increasingly important and require investigation.

Breeding and genetic research on the unique problems of swine is needed to speed the development of more effective practices in swine breeding. Rates of genetic improvement in economic value exceeding two percent per year have been demonstrated under limited and specialized conditions of selection. Research on techniques to extend this effort to a larger segment of the swine industry is urgently needed.

Swine breeding research should be expanded in detecting protein polymorphism in serum, milk, and other body fluids. Studies with laboratory animals and swine are needed to determine the relationship of the protein polymorphisms to economic traits of swine production. The proteins involved should be characterized and related to pedigree data in order to determine the type of genetic control involved. This information could identify swine seedstock possessing superior performance capabilities and lead to the development of more effective swine breeding selection programs.

The genetic and breeding research on single traits of major economic value should be accelerated and expanded to permit investigation of more traits, the interrelationships among important traits and the identification of interactions with environmental factors. Seasonal differences in production efficiency are recognized for reproductive performance, feed utilization, and carcass desirability. Clarification and development of methods for the exploitation of such relationships would accomplish substantial reductions in production cost and, at the same time, improve consumer acceptability of pork. Research is urgently needed.

Sheep. Expand research on intensive lamb production to develop practical systems of intensive management under various degrees of confinement. These systems would involve maximum use of gains from other research proposals to encourage large specialized units with greatly increased efficiency. New investigations are needed on breeding, feeding, and management practices to permit highly intensive production of lambs at all seasons of the year. This would include development of equipment and housing to reduce man-hours of labor required.

A national sheep improvement plan should be initiated to include research on implementation, development, and improvement of a nationwide performance and progeny recording system to increase the production and quality of lamb meat and wool. Such a system would lead to the genetic improvement of lamb production, growth rates, carcass merit, wool weights, and wool quality.

Continued research on breeding systems and crossbreeding is recommended at Beltsville. Different exotic breeds from foreign countries could be incorporated into the crossbreeding program. The question to be answered is whether or not these imported animals can be used effectively.

Lambs are being weaned at increased weights. Further research is needed to increase rate of gain so that lambs can be marketed at younger ages. Management and feeding systems need to be developed for feeders to prevent continued market gluts of heavy overfat lambs.

Goats. Additional research is needed to develop and improve Angora goat production and management practices.

E. Production of Animals and Products with Improved Consumer Acceptability

Poultry. Studies in genetics, nutrition, and environment are needed in an effort to improve egg shell quality. Losses in both commercial egg production and hatching eggs continue because of poor shell quality and texture.

Breast blisters and bruises incurred in the poultry house continue to be a major cause of downgrading in broiler processing plants. Studies in breeding, feeding, litter condition, equipment, and general management are needed to determine causes of these conditions, and recommendations developed therefrom to reduce the incidence of losses.

Beef. Research is needed on ways and means of measuring accurately the lean muscle mass in a nondestructive manner in live beef cattle. Higher grade beef carcasses average 20% waste fat. Eliminating this fat production could cut the retail price of prime and choice beef as much as 4 cents per pound. This wastage might be reduced by nearly 25% in the next 10 years with resulting annual reduction in production costs of some 84 million dollars if research needed to develop methods for increasing lean-fat ratios is pushed. Taste appeal and excess fat elimination need to be researched much further genetically. Muscle development needs much more attention.

Swine. The pork industry needs more evidence concerning the incidence and cause of pale, watery pork and factors that improve marbling and flavor. Increased muscularity of swine results in larger meat cuts than those customarily handled in segments of the meat trade. Greater research effort is needed to develop new products and production techniques that reflect the superior nutritional desirability of these meatier animals.

Sheep. The sheep industry has identified what it terms a "consumer-preferred lamb." Further research is needed on carcass quality to determine the actual cutout value of lamb carcasses and how this can be determined when evaluating a live lamb. Standardized methods are needed for fully evaluating the lamb carcass and its cutout value for use in many carcass contests across the country. Also needed are improved methods of more accurately determining the thickness of fat, size of loin eye, and percentage of trim to preferred cuts on a live animal.

The importance of wool quality and production should be recognized. Further research is needed to improve fleece weights and wool quality through genetics, physiology, and endocrinology of follicle and fiber development and wool growth.

F. Protection of Food from Harmful Micro-organisms and Toxins

Salmonellosis. The threat of salmonella contamination of poultry products poses an increasing problem in poultry production. Research is needed to study possible sources of infection and contamination in feed ingredients, birds and rodents, water, litter, dust, and human beings, as well as eggs and poultry. Further work needs to be done to determine how these organisms can be destroyed, particularly in feed ingredients and in hatcheries.

G. Agricultural Engineering pertaining to Livestock

Animal Wastes. Handling and disposal of animal wastes is an increasing cost factor as well as a major management problem in the production of meat animals, poultry, and their products. The problem is increasing as the result of antipollution pressures. While much fundamental information is available on the operation of waste disposal systems, additional research is needed to develop more efficient systems with lower operating costs. Also, research is needed to provide basic design criteria for the development of alternative disposal systems and the development of prototype systems to assist in the solution of the problem. Competition for land, pollution considerations, and cost of handling and spreading are denying the use of land disposals as one of the solutions. Narrow profit margins, market uncertainties, and lack of offsetting profits from waste byproducts have made it unrealistic to expect producers to develop and finance waste handling systems entirely on their own.

Mechanization of Livestock Operations. Availability of adequate labor for production of livestock, poultry, milk and eggs has become a critical problem. The chores associated with this production are onorous and confining -- 24 hours a day, 7 days a week, and 52 weeks a year. Farm labor is finding more attractive and better paying employment in the cities and in newly established nearby rural industries. To meet the competition and remain in business, the livestock producers must increase the efficiency and labor attractiveness of their operations by improving the design and layout of facilities and by using mechanical and electrical equipment to supplement available manpower. The problem is national in scope and involves all types of livestock and poultry enterprises. An integrated engineering, economic and animal husbandry research program is needed to develop and evaluate under controlled conditions of environment and management, alternative designs, layouts, equipment, controls, and production systems.

Dairy Equipment. Basic multidiscipline research on the mechanics and physiology of milking is needed to determine more definitely the relationship of mechanical milking to the incidence of mastitis and to develop new or improved milking equipment. Also, research is needed to develop suitable meters for use in measuring individual cow production and bulk milk from tank to tank. This research is critical to the effective operation of the National Dairy Herd Improvement Program and for equitable payments to producers using bulk tanks.

IV. ANIMAL HEALTH

A. Diseases of Livestock and Poultry

In the "National Program of Research for Agriculture" a set of broad national goals was developed. In order to carry out research aimed at helping to achieve a particular goal it was necessary to establish manageable subareas. These have been defined as "problem areas" of which there are 91. The subcommittee on Animal Health thought their recommendations would be more meaningful if set against the backdrop of the national problem area which follows:

> "Infectious diseases represent the single greatest hazard to the production of an adequate and wholesome supply of animal protein. They are a constant threat to the livestock or poultry producer who can be wiped out of business by a catastrophic disease outbreak. This hazard increases as the prevalence and severity of a disease increases. The total losses to the public from animal diseases will exceed $2.6 billion annually by 1980 if continued at the present rates. Losses result from mortality, reduced productivity, cost of treatment or immunizations, cost of regulatory programs, and condemnations of meat at the slaughterhouse. Some diseases which cause losses in animals are also transmissible to man."

Within this frame of reference the Committee makes the following specific recommendations:

Cattle:

Mastitis is the most serious animal health problem of the dairy industry. Because of the many factors involved in the causes and spread of the condition, much additional research is needed at the multidiscipline level directed especially at management, physiological, and genetic factors. Also, the studies should include an evaluation of the leucocyte determination as it is applied to market milk to validate an indication of mastitis in dairy cows. The leucocyte count should be clarified as a possible means of identifying mastitis in the use of herd management studies.

The Respiratory Disease Complex is responsible for the greatest monetary losses to cattle producers of both beef and dairy types. Morbidity and mortality are high in calves, feedlot, and breeding cattle. There is need for additional information on causative agents, preventive and therapeutic measures.

Enteric Diseases of Calves and Young Cattle cause losses up to 20% of calves before they reach 6 months of age. It is recommended that coordinated research by State Experiment Stations and the Department be continued and expanded.

Brucellosis research should be continued to provide information on the most effective age for calfhood vaccination and to develop a simple and accurate test that will distinguish between the titers resulting from infection and from vaccination.

Bluetongue, which has been considered to be a disease primarily of sheep, has been diagnosed in cattle. The effective research program on the disease should be expanded and accelerated to develop a means of identifying carrier animals and to identify additional possible vectors.

Pinkeye (Infectious Kerato-Conjunctivitis) continues to cause much loss of beef and milk production. There is need for much additional information on the condition.

Vibriosis is responsible for impaired reproduction through abortions and infertility. The recently developed bacterins have reduced losses but need further testing in the field and careful evaluation.

Leptospirosis, which occurs in other animal species and humans as well as cattle, needs further study. The many strains of the organism make this a complicated and difficult problem to control. Research is needed especially to determine the serotypes that infect cattle in this country.

Bovine Lymphosarcoma (Leukosis) because of its possible threat to humans should receive additional attention to learn the ways it is spread and to clarify the causative agents.

Foot Rot is still a serious problem in cattle with resultant weight loss. The causes of the condition are not known and much additional study is justified.

Tuberculosis and Paratuberculosis (Johne's Disease), which are caused by the acid-fast group of bacteria, are still problems. In spite of progress toward eradication of tuberculosis, more refined and specific diagnostic agents are needed to complete its eradication and to detect carriers of paratuberculosis organisms.

Bloat and Other Metabolic and Digestive Disturbances need much additional research emphasis in the hope of eliminating these hazards from livestock production. In spite of encouraging advances in recent years, bloating of animals continues to be a major problem in connection with legume pasture, native range, and in feedlot cattle.

Foot-and-Mouth Disease and Other Exotic Diseases, all of which are a constant threat to the nation's herds, should receive continued and expanded study.

Poultry:

Avian Leukosis continues to be the most baffling and costly disease in poultry. The disease is now rapidly becoming the number one disease threat to profits both in broiler production and egg production. Although much research has been devoted to the problem of leukosis for many years, there is still only limited knowledge regarding the spread of this disease and few answers are available to curb soaring losses occurring in all phases of poultry production. The Committee commends the Agricultural Research Service on its decision to assign research on this problem to competent scientists in several locations simultaneously and believes that this approach should be enlarged and expanded wherever possible until answers are obtained or new facts discovered which would indicate a different approach for control. This will utilize the talents of more scientists on

the problem. Particular emphasis should be placed on studies involving transmission, control by sanitation, and possible development of a vaccination program for Marek's disease until more fundamental and basic research can point the way toward complete eradication.

Mycoplasma (PPLO). Mycoplasma infection in poultry continues to be a major problem and is responsible directly or indirectly for great losses to the industry. We strongly urge expanded research on this problem to determine methods for the eradication or control of this disease condition.

Salmonellosis. Salmonella infection in poultry and poultry products continues to be a serious problem for the industry. We are pleased to learn of the progress that has been made during the past year, especially at the Athens laboratory regarding fundamental knowledge on egg infection. We recommend that this work be continued and expanded hopefully to determine methods to prevent egg infection.

Gumboro Disease (Avian Nephrosis). This disease is of serious proportion in the eastern part of the United States and we recommend the initiation of a research program to study the problem and develop methods for its eradication or control.

Hemorrhagic Enteritis. Enteritis in turkeys appears to be a serious problem in some areas. Because of the limited knowledge now available, we recommend continued study to develop ways and means for its prevention or treatment.

Swine:

Research on diseases of swine is still well below the level justified by the importance of this segment of the livestock industry. The Committee again recommends that additional steps be taken to correct this situation.

Reproductive Diseases, including the Mastitis-Metritis Complex, are responsible for heavy losses. This may be through death of fertilized ova, baby pig deaths from infection by a number of agents: bacteria, fungi, viruses, and by failure of the sows to produce milk. All of these aspects are in urgent need of study in the immediate future.

Respiratory Diseases, which include virus pneumonia, influenza, pasteurellosis, and bronchitis, need further investigation. Mycoplasma (PPLO) seems to be involved with extension to joints, reproductive systems, and other organs. Confinement rearing makes these and enteric diseases increasingly important problems.

Enteric Diseases are responsible for death of large numbers of young pigs. Progress is being made in the control of virus forms but additional research is needed on the forms caused by bacteria, fungi, and other agents.

Abscesses in the neck, jowl, and other parts of the body are responsible for an estimated annual loss of $12,000,000. The Department is to be commended for initiating research on the problem and it is recommended that the research be expedited and expanded.

Hog Cholera. Eradication is proceeding in an encouraging manner. Additional research is still needed on diagnostic methods, identification of virus strains, and complicating infections.

Sheep and Goats:

Epididymitis is a frequent cause of sterility in valuable rams. There is an urgent need for increased effort in research regarding the cause, transmission, prevention, and possible eradication of this disease.

Mastitis. The economic loss from mastitis is of serious concern to sheep raisers and with the good prospects of intensified breeding programs through estrus synchronization and artificial insemination, there is a need for research on the prevention and control of this disease.

Scrapie. The progress that has been made in the research effort in the United States in recent years regarding this disease is highly commendable and continuation of the program is urged.

Vibriosis. There is need for continued research in order to better control and/or eradicate this disease from flocks in this country.

Bluetongue. Continued and expanded research should be conducted on this disease as it relates to sheep and cattle. (Note recommendation under "Facilities - Denver Laboratory.)

Urinary Calculii. This poorly understood clinical problem frequently encountered in feedlots should receive increased research attention and methods developed for its prevention.

Foot Rot. A research program on this condition in sheep should be initiated in order to have practical methods for prevention and control.

Listeriosis. A bacterial disease that is of concern to sheep producers. Research studies are recommended to develop preventive measures.

Stiff Lamb Disease. This disease condition is not well-understood at the present time and, since it is of concern in some areas of the country, basic research is needed to determine the cause and to develop methods for its control or eradication.

Horses:

The Committee commends the Department for initiating research on two serious diseases of equines.

Equine Piroplasmosis, a protozoan disease that is transmitted by ticks, is under study. While some progress has been made, there is urgent need for more research on insect vectors, the character of the causative agent in the vectors, an immunizing product, and therapy of acute and carrier cases. A suitable experimental host animal is needed also.

Equine Infectious Anemia is a virus disease transmitted by insects. A test for carrier animals has been developed but there is need for its refinement to permit greater accuracy to find an acceptable experimental host, an immunizing agent, and therapeutic agents.

Reproductive Diseases are responsible for lowered conception rates in mares and death of foals. Research should be conducted on these problems.

Nutritional Diseases are responsible for apparent injury to bony structures of young horses. Only a limited amount of privately financed research is being done.

B. Parasites of Livestock and Poultry

For the reasons given at the beginning of the previous section, the "problem area" as stated in the "National Program of Research for Agriculture" is cited:

> "Internal parasites, such as various kinds of worms, flukes, and coccidia, cause losses in all parts of the country and in all seasons. In general, warmth, moisture, and shade favor parasites. About 300 kinds are of economic importance in the United States and will cause losses estimated at $650 million annually by 1980 at present rates. Severe infestations of parasites may cause heavy direct losses to the livestock producer but internal parasites generally are unseen, their effects are not apparent, and the loss to the public from inefficient production is hidden. Losses include mortality, reduced yield, condemnation of meat, feed wastage, and cost of drugs. Even for the parasites that have been the subject of considerable research, treatment or control measures are far from adequate."

The following specific recommendations are made:

Gastrointestinal Parasites are responsible for extensive morbidity and mortality, especially in young animals, of all species. Also, these parasites cause lowered efficiency of production in adult animals. New chemotherapeutic agents are being developed by the chemical industry, however, there is a need to study additional agents, especially for tapeworm, capillaria, and strongyloides. Also, research is needed with respect to developing prophylactic agents as well as methods of treating large numbers of animals.

Lungworms. Lungworm infections are recognized as serious problems in cattle, sheep and swine. At the present time no effective methods for prevention or treatment are available. Research should be initiated in order to develop methods for prevention and/or effective treatment for use in these three species of animals.

Trichinosis. A number of industry groups have mentioned this problem as it relates to public health and its presence prevents the export of fresh pork products to certain countries. In view of these problems and the effect it has on the swine industry, methods for the rapid detection and control are urgently needed.

Anaplasmosis. This disease, caused by a blood parasite, continues to cause serious losses both in morbidity and mortality in cattle. It is recognized in approximately 20 states. There is an urgent need to better characterize the organism and to find a suitable experimental animal so that additional knowledge may be developed about transmission, especially by insect vectors. Some progress has been made regarding prevention of this disease, however, much remains to be learned about the use of the vaccine for prevention as well as chemotherapeutic agents for treatment.

Trichomoniasis, a protozoan disease of the reproductive tract, is responsible for impaired fertility and causes abortions in cattle. Progress has been made in the treatment of bulls by oral or parenteral treatment with a chemical agent but additional research is needed.

Coccidiosis. This protozoan disease, especially in poultry, is widespread even though new compounds and also a vaccine are available for use in prevention of such infections. Continued basic research is warranted to develop new and improved methods for the control of this disease.

C. Protection from Toxic Chemicals, Poisonous Plants and Other Hazards

The "problem area" statement contained in the "National Program of Research for Agriculture" points out the need for research in this area:

> "Livestock and poultry may suffer losses in productivity from atmospheric pollutants and pesticide residues remaining on crops used for animal food. Poisonous plants can cause heavy losses, particularly when pasture or range feed supplies are short or at seasons of the year when these plants are not discriminated against by the grazing animal. Predators cause heavy damages to sheep and turkeys."

The Committee commends the Department for the research on poisonous plants that has aided sheep and cattle producers in range areas. Continued research is needed on plant, chemical, and radioactive toxic substances. Completion and staffing of the laboratory in Texas will permit acceleration of this important program.

D. Livestock Insects and Other Arthropods

The Committee is concerned with the lack of emphasis given to insects associated with livestock and poultry diseases. Because of the importance of this phase of research, we urge that additional funds and facilities be made available for this type of work. Studies should include the life cycle of insects, their part as vectors or reservoirs of disease-producing agents, mode of transmission of disease to livestock and poultry, and the use of biological and chemical agents in the control of such insects.

V. UTILIZATION, NUTRITION AND CONSUMER USE

A. Utilization Research

This Committee recommends research which seeks to provide a useful base of fundamental information as a springboard for innovation to improve consumer satisfaction and protection and to meet changing social needs and economic demands.

Dairy Utilization - Food:

Salmonella. The Committee recommends an expanded program of research on growth, survival and death of selected salmonella types in various dairy products under varied environmental conditions including research on the effects of temperature, humidity, pH, salts, sugars, and other ingredients of dairy products. Research should be done on development of processing procedures designed to eliminate all possible sources of contamination of dairy products and on development of ways to destroy pathogenic organisms which may be present in packaged products. Performance tests under pilot and industrial conditions to establish effectiveness of the developed methods should be made.

Utilization of Whey. Because of the increasing centralization of whey production, enactment of more stream antipollution laws, and present utilization of only about half of the 18 billion pounds of whey produced each year, further utilization research on whey is urgently needed. Such research should include cost reduction in concentrating and drying methods and development of new food uses.

Flavor. Flavor is one of the most important attributes of milk and milk products and greatly influences their utilization. There is a dearth of information on the nature of desirable milk and milk product flavors as well as on undesirable flavors which may occur naturally or develop during storage. Research should be pushed forward as rapidly as possible toward solution of these problems.

Cheese Research. Develop a continuous cheesemaking procedure by expanding basic and applied research on milk coagulation, curd formation, and flavor improvement. While substantial progress has been made in development of a low-fat cheese, research should be continued to improve the stability of this product to meet the needs of commercial distribution.

Bacterial Spores. Greater emphasis should be given to basic biochemical research on bacterial spores to elucidate the mechanism of spore dormance and spore germination which would make possible lowering the degree of exposure to heat during processing resulting in a corresponding increase in the quality of sterilized milks and other foods.

Instant Whole Milk Powder. The Committee recognizes development of a flavor-stable beverage quality instant whole milk powder as a prime goal toward which substantial progress has been made and recommends that all avenues of research, evaluation, and development leading to commercial acceptance be vigorously pursued and that adequate time and funds be provided to complete this project. Research is needed on improved gastight packaging.

Milk Fat. The Committee recommends expansion of basic and applied research on milk fat and its fractions with emphasis on their flavor stabilities, physical properties, and suitabilities for specific food uses.

Meat Utilization - Food:

New methods should be developed for detection and control of micro-organisms of public health significance such as staphylococcus, salmonella and spore-forming micro-organisms in meats and meat products. Methods are needed which will preserve the naturally fine qualities of meat and meat products while assuring wholesomeness for institutional and home consumption.

Basic and applied research is needed to develop effective methods for extending the shelf life of packaged meats and meat products. Such research is needed to enable the meat industry to make intelligent choices among methods which would improve the economics of meat distribution and provide better products for consumers. Specific examples of such research are:

Safeguarding Quality of Meat Products. Research to safeguard the quality of meat products should be expanded. The relationship of processing techniques to microbial growth encompasses numerous variables. Current studies represent only a fraction of the effort needed to provide basic information regarding micro-organisms that endanger products with widely different characteristics and components now being produced, shipped, and stored in everwidening market channels. Another phase of research should be devoted to studies of natural inhibitory substances in meat products and their effects on the viability, infectivity, toxigenicity, and pathogenicity of selected micro-organisms.

Extending the Shelf Life of Prepackaged Meats. Recent economic studies have shown that substantial savings in meat distribution costs could be made if carcasses were centrally cut and packaged. Present estimates indicate that these centralized operations would require more time in the distribution channels than is available as good shelf life of the product. Research is needed on methods of pasteurization and pigment stabilization which would extend the life of retail packages to 8 or 10 days without detracting from meat quality. A certain amount of basic research should be part of this project since many sources of variables in the shelf life of prepackaged meats are still a mystery. For example, it is often observed that some meats with very high microbial counts are organoleptically quite sound while others with relatively low counts may be unpalatable. Research in the bacterial ecology of prepackaged meats has not been sufficiently rigorous to explain this anomaly.

Poultry and Egg Utilization - Food:

Chemical Composition and Physical Properties. The rapidly changing poultry industry makes important use of fundamental information of poultry and eggs. Recent findings on the interaction of egg proteins that are of potential practical significance emphasize the importance of fundamental studies. Basic studies of chromogenic proteins may lead to an understanding of the sporadic occurrence of unnatural pink color in cooked products. Research

should be expanded on the composition and properties of components of poultry and eggs in order to provide a continuing sound basis for the development of new processes and products and for solving troublesome problems as they arise.

New and Improved Poultry and Egg Products. The increasing demand for ready-to-serve poultry- and egg-containing products of high quality whether cooked, frozen, canned, or dried offers important opportunities for increasing poultry meat and egg markets. An expanded research program on the major factors influencing quality, stability, wholesomeness, and processing costs is needed. The program should include only a limited effort on formulation. Major emphasis should be placed on developing principles of processing and storing that would be widely applicable in the production of superior poultry meat and egg products and on the development of products that would be useful in formulation of other foods including emulsifying and binding properties of component parts. Studies are needed to determine chemical and physical properties of texture and other quality changes in poultry meat caused by processing such as canning, dehydration, and irradiation as a basis for developing superior products that can reach markets with little or no special handling. The effect of recurrent freezing and thawing on the quality of young chickens should also be studied.

Processing Poultry for Optimum Tenderness. Under present continuous-line processing procedures, optimum tenderness does not develop in poultry meat. The alternative, the use of long-time tenderizing periods, is inconvenient and costly. In order to accelerate the development of rapid, economical processing methods that also assure tenderness, basic and applied studies of tenderness should be expanded with emphasis on the mechanism of tenderization and the processing factors that influence it.

Flavor of Poultry Meat Products. Much of the frozen, dehydrated or otherwise processed poultry has varied widely both in natural poultry flavor and in development of off-flavor. A great deal of knowledge has resulted from research on poultry flavors at the Western Utilization Laboratory. The studies should be expanded to apply this information, to develop additional information, especially to develop a more exact relation between specific poultry constituents and organoleptic response. A special study should be made of the character of "warmed over" and "off" flavors because of the increasing production of prepared poultry products.

Improvement of Salmonella Destruction Treatments. While successful pasteurization of egg products is being practiced commercially, further specific studies should be conducted to thoroughly evaluate important physiological and environmental factors that influence the resistance of salmonellae to destruction in order to develop milder and less costly pasteurization treatments for all types of egg products. Research should be initiated to develop pasteurization treatments for poultry products. In both cases, studies are needed to determine the processing and control steps necessary to avoid cross contamination and postpasteurization contamination. (See also the general recommendation on salmonella.)

Food and Industrial Uses of Animal Fats:

Edible Animal Fats. There is urgent need for research that will facilitate production of a larger amount of total U. S. animal fat as edible fat. Such a shift in production would increase the world food supply substantially and simultaneously increase the return to the livestock industry. This objective can be achieved by processing and handling animal fats so as to permit production of a greater proportion of edible tallow. Data are not available on which an estimate can be made as to how far this shift could be made without changes in the basic methods for marketing beef such as development of central meat cutting operations. However, scientific foundations for such a production shift must be broadened in the areas of fat stability and chemical modification to produce animal fat products with improved physical properties.

Inedible Animal Fats. The 4.5 billion pounds per year output of inedible animal fats is one of the important byproducts of the livestock industry. It is of major concern because during the past fifteen years production has doubled while use in soap declined by half. The most promising potential for increasing uses for inedible animal fats appears to lie in the further development of new chemicals which are useful in such large volume outlets as plastics, plasticizers, lubricants, lubricant additives and biodegradable detergents. Development of fat-based detergents with their superior biodegradability would be an important contribution to the solution of problems related to preservation of supplies of potable water. Research should be expanded to provide the information and background essential to development of new products for these market areas and public needs.

Wool and Mohair Utilization:

The Department's WURLAN treatment of wool for machine washability and shrinkage is receiving increasing commercial and military attention. (See Also general recommendation on facilities for the woolen system.)

Durable Press. The Committee strongly urges greatly accelerated research toward development of superior durable press wool and mohair apparel products through new chemical treatments and scientifically designed woolen and worsted fabric structures. Durable press is of significant importance to the consumer. Superior wool and mohair products that could result from this research would provide savings to the consumer in apparel upkeep and service costs.

Composition and Physical Properties. Basic research on wool and mohair composition, structure, and stability needs to be continued and expanded in order to increase the probability of treatments likely to emerge as breakthroughs for future development of new and better products. Modifications of wool are needed that impart permanent resistance to wrinkling, soiling, yellowing, and to microbial and insect attack.

Modified Wools and Mohair. Research should be expanded on the chemical grafting of polymers to wools and mohair that may lead to new desirable multipurpose performance characteristics. In addition, the possibility should be investigated that chemically modified wools and mohair can be developed that would increase the percentage of these fibers now used in blends with synthetic fibers.

Hides, Skins and Leather Utilization:

Physical, chemical and biological investigations on hides and skins need to be strengthened in order to develop information on the properties of collagen and the other components to permit their use in areas other than the traditional leather markets. Emphasis should be continued on investigations of the dispersion and reconstitution of collagen fibers from the less desirable areas of hides and skins to create new and nonconventional products especially for utilizing its mechanical and physical properties as matrix and structure in food application. Following upon the successful commercialization of glutaraldehyde tanning of cattle hides for improved shoe uppers and of wool skins for launderable hospital bedpads and improved paint rollers, continued studies are recommended on the chemical modification of hide proteins to develop leathers with additional new and improved properties that will enhance the comfort and utility of footwear and leather articles.

Studies should be initiated on the engineering aspects of hide processing to evaluate equipment and to develop processing methods for dispersing collagen.

Investigations should be intensified on the elimination of hide defects with a view to improve the quality and uniformity of leather and on the development of new processing methods including studies on pickling, to obtain greater economies in leather production in order to enhance its competitive position with the growing body of substitutes.

B. Human Nutrition and Consumer Use Research

See general recommendation on Central Headquarters for Human Nutrition Research.

Basic Nutrition Research. The Committee commends the Department nutritionists for their leadership in studying the interrelationships among food components in supporting long-term health and well-being of individuals. We remain keenly interested in the problems of fat and cholesterol metabolism in people and in the progress being made in determining the extent to which foods from nonanimal sources influence the pathways by which the foods of animal origin are used by the body, particularly in the synthesis and deposition of fat and cholesterol. These leads need to be followed up and extended to provide an increased evaluation of the roles of hormones, environmental stress and physiological functions, all of which are basic to a better understanding of differences in nutritional needs among individuals. The Committee places highest priority on expansion of this research to permit a clearer understanding at an early date of the role of diet in determining the biochemical mechanisms of fat and cholesterol synthesis and breakdown and the associated physiological change.

Safe Food Handling Practices for the Consumer. The Committee again directs attention to the need for improved procedures for safeguarding the wholesomeness of raw and cooked foods after they reach the consumer. Research is needed on the problems encountered in homes and institutions in maintaining the microbial safety and eating quality of foods where it is not practical to provide specialized storage for individual food items. Great care is taken to minimize or completely prevent contamination of food during

processing and marketing and still the number of illnesses due to food poisoning remains at a high level. In almost all cases the cause can be traced to improper handling by the consumer. Research should be undertaken at once to obtain data directly applicable to the problems met by consumers. (See also general recommendation on need for consumer awareness on food safety.)

Tables of Food Composition. Demands are constantly increasing for the information on the nutritive values of food as provided in Agriculture Handbook No. 8, "Composition of Food -- Raw, Processed, Prepared." The Committee urges that these data be continually reappraised for use with current food products, updated as needed, and supplemented to provide information on additional nutrients and foods. Values on the composition of foods need frequent revision to take into account changes in composition resulting from recent wide-scale developments in production practices; from advances in manufacturing, preservation, and marketing procedures; and from changes in preparation practices in homes, restaurants, and other institutions. The Committee urges the initiation of such research as necessary to provide reliable data on nutritive values for important items of diet, for example, poultry and meat, certain dairy items that were omitted or scantily treated in the Handbook for lack of suitable information on their composition.

Food Consumption Survey. The Committee stresses the urgent need for the release of the data from the 1965-66 nationwide survey of food consumption. The wealth of information collected in this survey on the kinds and quantities of food including dairy, meat, and poultry products consumed by families and individual family members in this country as a whole and by region, different degrees of urbanization, and different levels of income has important implications for the entire food industry and is basic to the development of nutrition programs. For maximum usefulness it is essential that the information on food practices and dietary levels of families and individuals be made available promptly.

Improving Children's Food Habits. The Committee recommends that a study be made to provide information on the diets and nutritional status of preadolescent children and that information be obtained on those socioeconomic and food management factors that are believed to be closely related to nutritional status. It is recognized that effective guidance for improving children's food habits requires supplementing information on food practices by a knowledge of the factors that will bring about desired changes. A pilot study needs to be made to investigate the components of food habits and to identify the most effective procedures for improvement. The information gained from this study will be useful in directing future research on dairy, meat, and poultry products.

VI. MARKETING AND ECONOMICS

A. Market Quality

Dairy Products:

Market Quality of Fluid Milk. Recent developments in the handling, transportation, and processing of fluid milk have caused many changes in the merchandising of this product. Research should be initiated to determine the effect of these new practices on the keeping quality of fluid milk. Information is needed on (1) the effect of the ultrahigh temperature extremely short-time pasteurization procedures on flavor and other quality attributes of milk during the time it is in storage and channels of distribution, and (2) on the numbers and kinds of micro-organisms in milk marketed under these newly created conditions.

Insects Attacking Dairy Products. There is need for a new assessment of the kinds of insects and mites infesting facilities where dairy products are manufactured, stored, and shipped. It has been several years since field studies were conducted and in the meantime there have been changes in industry procedures as well as in insect control practices. The recent discovery of a previously unreported species of the black carpet beetle complex in Wisconsin emphasizes the need for additional investigation. Current information on distribution, abundance, and relative importance of the several kinds of insects and mites involved is needed as a guide for issuing control recommendations and for steering the nature of the research program.

Poultry and Eggs:

Salmonella in Eggs, Poultry and Poultry Products. The highest and most urgent priority should be given to reducing the incidence of salmonella in eggs and poultry. Investigations are needed to determine under what conditions salmonella proliferate in poultry, eggs, and in egg and poultry products during handling, storage and distribution. For this purpose and for use in poultry inspection, simple, rapid and economical methods are needed for detection of salmonella.

Quality Maintenance of Eviscerated Poultry. Research should be continued to determine the effects of various existing methods (as well as new or improved methods) of slaughtering, scalding, defeathering, eviscerating, chilling, packaging, transporting, and holding on the quality of eviscerated chickens and turkeys. Factors such as appearance, shelf life, flavor, tenderness, and wholesomeness as affected by various processing techniques should be studied. Basic research to elucidate the physiological, chemical and physical processes involved in the maintenance of poultry meat quality should be an integral part of this study.

Wholesomeness of Poultry. Immediate research is needed to establish whether or not the wholesomeness of an entire bird is affected when small evidences of leukosis on the skin or internal organs are visible.

Livestock, Meat, and Wool:

Measurement of Market Quality. Research is needed to provide improved methods of quantitative and qualitative evaluation of both live animals and dressed meat. There is need to develop accurate methods of measuring the ratio of lean muscle mass to fat tissue.

Shelf Life of Fresh Meat. Additional research is needed to increase the shelf life of fresh meats in retail markets in addition to the research already conducted on refrigeration, sanitation, and lighting.

Standards for Meat Grades. Additional research is needed to provide better methods for determining more meaningful meat grade standards. Present standards provide for grading beef from steers, heifers, and cows without sex identification. Beef from bulls and stags is graded as bull beef and stag beef, respectively, and identified for class as "bull beef" or "stag beef." At present, the quality in a designated grade of bull beef (and stag beef) is not comparable with a similarly designated grade of beef from steer (heifer and cow.) It is recommended that this problem be brought to the attention of the Grading Service of the Livestock Division, Consumer and Marketing Service, for early consideration and inclusion in grade standards and specifications.

Objective Measurement of Wool Quality. Improvement of present methods for measuring quality factors of the wool fiber would contribute to the development of better grading procedures that would be more closely related to processing performance and product quality. Technical comments from mills would be helpful.

Standards for Mohair Classification. Mohair standards are needed. A set of standards for mohair classification should be established including measurement of fiber length, density, fineness and character.

Fabric Insect Control. The insects that attack woolen fabrics and animal hair products are a major cause of losses by stored-product insects. The individual items damaged or ruined are often expensive and the attack is widely dispersed. In analyses by State Extension workers, the number of requests for information on fabric-insect control leads all other insect inquiries in most states. Research should be expanded to take care of urgent needs by the Armed Forces, homes, and industry for nontoxic moth-proofing treatments and for safer, more effective measures to combat fabric-insect infestations in the structure of homes and commercial establishments.

Effect of Surfaces on Insecticides. There is urgent need for resumption of research on the effects of surfaces on the degradation of insecticidal deposits. The greatest problem area is where insecticides must be applied on concrete and acrylic-latex painted surfaces in dairy or other food product processing plants and in storage warehouses.

B. Equipment and Facilities

Transport Equipment and Techniques:

The Committee feels that current work on multipurpose transport vehicles should be expanded, particularly the research on the compartment-type van for large shipments.

Recent improvements in air transport have increased the opportunities to expand its use in marketing a number of agricultural perishables. These improvements include larger and faster planes such as the new 747 and 727 QC all cargo jets with lower operating costs, containerization and improved cargo handling methods. The speed of air transport and improved handling techniques should bring savings in packaging, handling, and refrigeration costs and reduce product and quality losses. Research should be undertaken to find ways to use this new technology to do a better job of transporting perishable farm products.

Consumer Packages and Shipping Containers:

The Committee feels there is need for further research on consumer packages and shipping containers for poultry and on the equipment used for handling products. Although this area of research was advised against last year, it is now felt that private industry is not meeting the need as expected in this area.

Poultry and Eggs:

Research is needed to develop egg handling methods and packing plant procedures for reducing shell egg damage and to develop facilities, equipment, and/or methods for handling powdered egg and other poultry products to eliminate contamination hazards in handling and/or packaging finished products.

In the turkey eviscerating process over fifty percent of the labor required to prepare turkeys in ready-to-cook form is expended in the eviscerating operation. Frequently at peak production rates, the eviscerating line crew is out of balance because one or more of the operations is slowing other operations on the line. Research is needed to evaluate methods for improving crew balance and to develop improved equipment for use in the eviscerating operation.

After reviewing three of last year's recommendations, the Committee supports plans for continuing and expanding work on handling and bruising of live poultry and the initiation of work on water conservation in poultry processing plants and on processing engineering later in the year as other research projects are completed.

Livestock, Meat and Wool:

Engineering research is needed on layouts and operating criteria for livestock auction markets. Research on these problems has not been conducted since the period of 1949 through 1957. There is a real need to broaden and update this research.

Research is needed to develop an automated system for handling sales data on livestock markets. Such a system should provide an automatic sales transmitting, processing, and recording system to increase the efficiency of the selling operation, minimize the possibilities of manmade errors in computation, speed up payments for animals following their sale, and reduce total labor requirements. The approximately 1,725 livestock auction markets in the United States process sales data in practically the same way now as in the early 1930's. Sales data are recorded and transferred manually from the arena to the market office where office personnel make all computations and prepare the necessary records and accounts including the seller's checks. Excessive labor costs in data transmission, processing, and recordkeeping are common.

Engineering research is needed in wool warehouses to develop standards for container sizes for receiving wool and packages for handling, storage and equipment.

The Committee recommends continuation of research in four specific areas: The handling and processing of "hot" pork products, development of an automated system for driving and penning livestock, developing electrically-operated pen gates for livestock markets, and layouts and work methods for small inedible rendering plants. The work on hot pork products will make it possible to change from feasibility experiments to developmental research on a prototype quick-chill cabinet for a pilot "hot processing" line which will facilitate the early adoption of research results by industry.

C. Economics of Marketing

The Livestock Marketing System:

The Committee recognizes the substantial contribution made by the Marketing Economics Division of the Economic Research Service to the report of the National Commission on Food Marketing by making available studies pertaining to the livestock marketing system. These data will provide important benchmarks for future reference. In light of these studies we recommend that all data on market channels, price spreads, and similar and related data be kept current and made available as a regular series. With all this information developed to date, including the report of the National Commission on Food Marketing, we still do not have an overall evaluation of the effectiveness of the livestock marketing system in the United States. This Committee has twice recommended an overall study. Because of the existing siutation in which we have a great number of markets or points at which livestock may be delivered, e.g., 200 points in one State where hogs may be received, along with considerable decentralization of markets and a great variety as to types of markets, there is need to evaluate the present system in two important areas: (1) the effectiveness and cost of such a system to livestock producers and the industry, and (2) the effectiveness of pricemaking under such a decentralized, diverse and multiple system.

Formula Pricing. Formula pricing appears to be on the increase in both meats and livestock. Research is needed to appraise the effect of the increased use of formula pricing on the base prices used in the "yellow sheet" for meats and on prices of livestock in terminal markets.

Transportation. Transportation and the distribution of live animals and meat products is an important part of the marketing process. A study should be made to determine the cost and effectiveness of present patterns and problems of transportation and distribution of live animals and meat products.

Trade Barriers in the Dairy Industry. The National Commission of Food Marketing and others have recommended study of the costs of overlapping health jurisdictions and impediments to the movement of milk both in bulk and packaged form. This study would determine the extent and cost of such duplicate inspections and other regulations.

Market Potential for Dry Whole Milk. Because of recent technical improvements in drying whole milk, a marketing assessment of the potential for instant beverage quality dry whole milk is needed to provide information on (1) legal barriers which may tend to obstruct the introduction of a dry whole milk into specific markets, (2) degree of storage stability required to allow for the movement of a dry whole milk through the channel from manufacturer to the point of consumption, (3) the probable acceptance of a dry whole milk by the dairy processing industry, (4) the farm price structure of raw milk to be used in the manufacture of dry whole milk and the effect the acceptance of a dry whole milk may have on the structure of farm prices for milk, and (5) an estimate of consumer prices relative to fresh whole milk, both retail and institutional, which will facilitate market acceptance of dry whole milk.

Integration in the Poultry Industry. Vertical integration is spreading in the egg and turkey industries, following past developments in the broiler industry. Basic studies are needed to determine how these producing, input-supplying and marketing functions can be fitted together most efficiently and where the various units should be located in a given supply and distribution area.

Poultry Outlook. Immediate research is needed to determine the effectiveness of a broader and faster report on pullet chick placements. If a weekly report on breeder eggs set and pullets placed were to be issued, it is felt that unknown variables would be minimized in poultry so that the marketing could be accomplished in a more orderly and expedient fashion.

Distribution of Lamb and Mutton. The sheep industry has relied heavily on a study of distribution of lamb and mutton in the United States as it occurred in 1954. Due to the high level of mobility of the population and its expansion, it is reasonable to assume that consumption patterns for lamb and mutton have changed since the 1954 study. It is recommended that research be conducted to bring the above study up-to-date.

D. Cooperative Marketing

Potentials of Integration. Information should be developed as an assist to farmers in appraising and developing feasible programs that will enable them through their own cooperatives to maintain control of their products at additional decision-making levels in production, distribution, marketing, and slaughter processing. These studies should determine costs and benefits in relation to changes in marketing structure.

Coordinated Marketing. Research is needed to determine geographic areas that offer greatest potential economic gain from coordinated marketing of related cooperatives. Research would then be needed to evaluate potential growth effectiveness and methods of coordinated marketing programs in selected areas.

Cooperative Structure and Organization. There is a need for cooperative marketing structures and organization to serve large territorial areas because of greater operating efficiencies, where production increases more rapidly in one area than in another, with patterns of regional surplus and short supplies changing rapidly. Regional cooperatives can help to increase marketing efficiencies and balance supplies interregionally.

Combinations of Cooperative Services. Research is needed to determine the most efficient combinations of cooperative marketing services and products for poultry producers based on market requirements. This research could help farm families and cooperatives schedule farm production, farm resources, and credit through cooperative management centers more effectively.

Pooling. Increased research is needed to assist cooperatives formulate a pooling system, or systems, designed to equitably distribute proceeds from sale of their product in multistate areas back to producers also widely located over large areas. Such research would assist cooperatives, particularly dairy cooperatives, in their current efforts to federate into large bargaining units.

E. Supply-Demand Research, Situation, Outlook, and Projections

The Feed-Livestock Economy. Operation of government programs for a number of commodities, including feed grains, causes concern as to the relationship between supported commodities and those which do not have price supports, such as livestock. Better and more up-to-date information on these interrelationships are needed to aid government officials and others in policy formulation for achieving and maintaining an acceptable level of prices along with a reasonable degree of price stability to both producers and consumers.

Intensified Sheep Production. More information is needed on the supply response and price effect of the production efficiency promised by intensified production of sheep. Experiences of a limited number of sheep producers show that the average number of lamb crops per ewe can be increased from about 1 to approximately 1½, thereby increasing returns per ewe and per hour of labor so that profits from the sheep enterprise increased substantially. Studies should be initiated to show (1) the economic feasibility of this production program in various regions of the United States, and (2) the total impact of the program on supplies and prices of lamb and wool.

Wool Competition. There is need for a study showing the demand and competitive relationship between wool and competing fibers. The need for a study arises from a changing situation in which the prospect for increased wool production in the United States and the world is coupled with increasing production of noncellulosic fibers, technological improvements in both classes of products, and increased advertising and promotion of wool.

Dairy Outlook. Increasing specialization and large investment in specialized dairy equipment require greater emphasis on outlook for intermediate and longer term periods. Improved estimates are needed indicating the resources required for various levels of milk production based on estimated domestic consumption levels, and possible levels of food assistance programs.

Milk Regulations. Dynamic changes in the production and marketing including growing interstate movement of milk have resulted in increased demand by producers and other elements of the dairy industry for government participation in milk pricing. State trade practice regulation also is growing. A comprehensive evaluation of these institutional conditions in the fluid milk industry is needed periodically. Such an appraisal was last done in 1965.

Forecasting Models. Re-evaluation as well as development of new short-run price and supply forecasting models is needed to account for the structural shifts that have occurred in the production of livestock and wool, as well as the changing patterns in demand.

F. Consumer Preference and Quality Discrimination

New Food Processes. The Committee feels that special priority should be given to determining and evaluating consumer attitudes toward foods processed by radiation methods. Knowledge of such attitudes would be of value in determining the direction of research efforts in the development and marketing of new food products, either pasteurized or sterilized by such methods.

Consumer Reactions to Various Food Products under Laboratory Conditions. With new food products appearing in increasing numbers, research should be expanded in the area of consumer discrimination and preferences for food products differing in quality and flavor factors. This research should be conducted through experiments in the sensory evaluation laboratory of the Special Surveys Branch on such products as dry whole milk and other dairy products. These small-scale studies conducted under controlled conditions give direction to later household placement tests, aid industry in planning efforts for more effective marketing, provide an evaluation of possible consumer acceptance of new developments or variations and provide insights into the effectiveness of scientific research designed to develop agricultural products with greater appeal and usefulness to consumers.

Consumer Reactions to Test Products Used in the Home. To assist in the initial efforts to market new and improved food products of agricultural origin most effectively, industry needs to know homemakers' reactions to such innovations. Research should be expanded on the opinions and preferences of consumers concerning new products through the placement in households, for use under more natural conditions than a laboratory provides, of various items such as dairy foods, as they approach commercial introduction. In addition to providing industry and the laboratories with information about any previously unknown or suspected shortcomings of new products (such as difficulty in reconstitution or in following reconstitution instructions), household placement tests which indicate better-than-average acceptance of a given product provide added inducement to a potential processor, and others in the marketing channels, to introduce the line.

Consumer Preference for Wool Products. Manmade fibers and blends have moved aggressively into the textile market and provided sharp competition for the natural fibers, making the need for sound information on consumer reactions on a nationwide basis even more urgent. Consumer preference research on wool and competing materials should be expanded to provide this information. Studies which should be given high priority include consumers' use of and preferences for fibers and fabrics in men's wear, children's wear, and household products.